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CONTENTS:

Synopsis of Rudbeckia Subgenus Rudbeckia. *Robert E. Perdue, Jr.* 293

Paraformaldehyde as a Source of Formaldehyde for Use in Botanical Collecting. *J. S. Womersley* 299

Notes on Some Jamaican Eugenias. *George R. Proctor* 303

Analysis of Vegetative Propagation in Quercus prinoides. *William M. Keith, Jr.* 306

Notes on the Habitat of Aster ptarmicoides. *Richard J. Eaton* .. 308

Errata 309

Index to Volume 59 310

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THE NEW ENGLAND BOTANICAL CLUB

Vol. 59 December, 1957 No. 708

SYNOPSIS OF RUDBECKIA SUBGENUS RUDBECKIA[1]

ROBERT E. PERDUE, JR.

Rudbeckia subgenus *Rudbeckia* includes those species in which the achenes are equably quadrangular with flat or convex walls that are completely filled and commonly expanded by the mature ovule. The achenes are typically truncate at the base and basally attached to the receptacle. The pales (chaff of the receptacle) are characteristically one and one-half to two times as long as the mature achenes. The group includes annual, biennial, and perennial plants.

This subgenus is essentially a group of eastern North American species. With the exception of the very weedy and widespread *R. hirta* var. *pulcherrima*, collections from beyond the eastern borders of the Great Plains are very rare. With the exception of *R. fulgida*, *R. hirta*, and *R. triloba*, the species occupy fairly limited geographic areas. *R. graminifolia* is apparently endemic to western Florida, records being available from but four counties.

The species of subgenus *Rudbeckia* are very distinct. No plants have been observed in the herbarium or during the course of extensive field study that offer even the most remote suggestion of interspecific hybridization. In nature the occurrence of colonies of two or more species within close proximity has been the rule rather than the exception.

The synonymy listed for the taxa is not necessarily complete; however, all important synonyms including names used in all of the floristic manuals have been included. Names of taxa below the rank of variety have been excluded. Most of these are included in the latest edition of Gray's Manual.

[1] The research upon which this paper is based was initiated while the writer was a member of the staff of the Texas Research Foundation, Renner, Texas.

A detailed discussion of the morphological and cytological bases for the separation of *Rudbeckia* into two well defined subgenera will be presented in a forthcoming paper.

KEY TO THE SPECIES OF RUDBECKIA SUBGENUS RUDBECKIA

a. Leaves lanceolate (rarely broadly linear) or wider, never more than 6 times as long as broad, venation obviously pinnate; pales rounded to acute or cuspidate, never mucronate; rays usually yellow, occasionally brownish-red at the base.
b. Style tips elongate, slenderly subulate .....1. *R. hirta*.
b. Style tips short and blunt.
c. Pales rounded, obtuse, or merely acute.
d. Pales glabrous or rarely pilose with a few loose white hairs near the apex, apex entire, ciliate, or erose; leaves never glandular.
e. Plants never stoloniferous, the leafy tufts arising only at the base of the stem; basal leaves broadly linear to lance-spatulate; stems and leaves densely villous-hirsute, branches sharply ascending .....2. *R. missouriensis*.
e. Plants commonly stoloniferous, most of the leafy tufts arising at the ends of the stolons; basal leaves lanceolate or broader; stem and leaves nearly glabrous, hirsute, or strigose (villous-hirsute only in var. *deamii*); branches distinctly spreading .....3. *R. fulgida*.
d. Pales canescent near the apex with short viscidulous hairs; leaves commonly glandular as evidenced by the presence of minute globules of clear brownish exudate (leaves non-glandular in *R. mollis* in which species stem is densely pilose near the base).
f. Leaves entire or coarsely toothed, never deeply lobed.
g. Stem densely pilose below; basal leaves spathulate and sessile or with broadly winged petioles; plant annual .....4. *R. mollis*.
g. Stem glabrous below or with a few coarse hairs; basal leaves broadly elliptical or ovate, borne on long slender petioles; plant perennial.
h. Achene crownless or crown, when present, very obscure; heads 4-8; rays spreading. 5. *R. heliopsidis*.
h. Crown of the achene conspicuous; head usually solitary; rays reflexed ....6. *R. grandiflora*.
f. At least some of the leaves deeply 3(-5)-lobed 7. *R. subtomentosa*.
c. Pales acuminate-cuspidate .....8. *R. triloba*.
a. Leaves narrowly linear, grass-like, at least 10 times as long as broad, veins apparently parallel; pales mucronate; rays deep reddish-brown to orange red .....9. *R. graminifolia*.

1. **Rudbeckia hirta** L. This is a complex species but hardly so confusing as would be suggested by the abundance of names that have been assigned to its variants. There are numerous local variants and minor forms that are unworthy of recognition. Within the species, however, five fairly well defined geographic variants can be recognized as outlined below, although where ranges overlap there is often great morphological intergradation between varieties.

KEY TO THE VARIETIES OF R. HIRTA

a. Stem branching above the middle (if simple, the peduncle not more than 1/3 as long as the height of the plant), the branches ascending; plant of wide distribution.
  b. Leaves coarsely toothed, basal leaves broadly elliptical to oval, 2.5-7.0 cm. wide, blades mostly twice as long as wide, cauline leaves ovate-lanceolate or ovate, the sessile ones commonly pandurate, plant mostly of Appalachian Highlands (Pennsylvania to Georgia and Alabama; sparingly north to Maine, west to Illinois) ....1a. var. *hirta*.
  b. Leaves entire or finely serrate, basal leaves narrowly to broadly oblanceolate or lanceolate, 1–2.5(–5) cm. wide, blade (3–)4–5 times as long as wide, cauline leaves spatulate, oblanceolate or broadly linear.
    c. Stem simple or branching near the middle, peduncles at least 7 cm. long, 1/5–1/3 as long as the total height of the plant (Newfoundland to British Columbia, south to Florida and northern Mexico; apparently rare west of the Rocky Mts.) .....1b. var. *pulcherrima*.
    c. Stem branching near the apex, peduncles 1–6 cm. long, never more than 1/7 as long as the total height of the plant (Virginia coastal plain) .....1c. var. *corymbifera*.
a. Stem branching at and below the middle (if simple, the peduncle at least ½ as long as the height of the plant), the branches divergent; plant of the lower Gulf Coastal Plain from Florida to southern Texas.
    d. Stem branching at or near the middle, rarely at the base, never scapose; leaves mostly pale green (to brownish when dry), hispid to somewhat sericeous, rough but never extremely harsh to the touch, basal leaves narrowly to broadly oblanceolate (coastal plain, southern Georgia to Florida, west to southern Texas) .....1d. var. *angustifolia*.
    d. Stem branching at or near the base, often scapose; leaves mostly dark green, scabrous or hirsute, very harsh to the touch, basal leaves broadly obovate or nearly orbicular to broadly oblanceolate (central and southern Florida) .....1e. var. *floridana*.

1a. **R. hirta** L. var. **hirta** (*R. hirta* L., Sp. Pl. **2**: 907. 1753; *R. brittonii* Small, Mem. Torr. Bot. Club **4**: 130. 1894; *R. hirta* var. *brittonii* (Small) Fern., RHODORA **39**: 457. 1937; *R. amplectens* T. V. Moore, Pittonia **4**: 177. 1900; *R. monticola* Small, Torreya **1**: 67. 1901; *R. hirta* var. *monticola* (Small) Fern., RHODORA **39**: 457. 1937.).

1b. **R. hirta** L. var. **pulcherrima** Farwell, Rep. Mich. Acad. Sci. **6**: 209. 1904 (*R. serotina* Nutt., Jour. Acad. Nat. Sci. Phila. **7**: 80. 1834; *R. bicolor* Nutt., Jour. Acad. Nat. Sci. Phila. **7**: 81. 1834; *R. strigosa* Nutt., Trans. Am. Phil. Soc. N. S. **7**: 354. 1840; *R. lanceolata* Bisch., Del. Sem. Hort. Heidelb. 4. 1848, ex Walp. Ann. **2**: 855. 1852; *R. serotina* Nutt. var. *lanceolata* (Bisch.) Fern. & Schub., Rhodora **50**: 175. 1948; *R. flexuosa* T. V. Moore, Pittonia **4**: 180. 1900; *R. flava* T. V. Moore, Pittonia **4**: 179. 1900; *R. longipes* T. V. Moore, Pittonia **4**: 178. 1900; *R. sericea* T. V. Moore, Pittonia **4**: 178. 1900; *R. hirta var. sericea* (T. V. Moore) Fern., Rhodora **39**: 457. 1937; *R. serotina* var. *sericea* (T. V. Moore) Fern. & Schub., Rhodora **50**: 175. 1948; *R. flava* T. V. Moore var. *perbracteata* Lunell, Am. Mid. Nat. **2**: 157. 1912.). This widespread weed was regarded as a distinct species (*R. serotina* Nutt.) in the latest edition of Gray's Manual. Recognition of this taxon as a variety of *R. hirta* necessitates the adoption of Farwell's name, the first legitimate name in varietal rank.

1c. **R. hirta** L. var. **corymbifera** Fern., Rhodora **39**: 457. 1937. (*R. serotina* var. *corymbifera* (Fern.) Fern. & Schub., Rhodora **50**: 175. 1948.).

1d. **R. hirta** L. var. **angustifolia** (T. V. Moore), comb. nov. (*R. floridana* var. *angustifolia* T. V. Moore, Pittonia **4**: 176. 1900; *R. divergens* T. V. Moore, Pittonia **4**: 177. 1900.). This taxon has become fairly well known under the name *R. divergens* T. V. Moore. Use of the less appropriate name, as adopted above is required when this entity is placed in its proper position as a variety of *R. hirta*.

1e. **R. hirta** L. var. **floridana** (T. V. Moore), comb. nov. (*R. floridana* T. V. Moore, Pittonia **4**: 176. 1900.).

2. **Rudbeckia missouriensis** Engelm. ex Boynt. & Beadle, Biltmore Bot. Stud. **1**: 17. 1901. (*R. fulgida* Ait. var. *missouriensis* (Engelm.) Cronquist, Rhodora **47**: 401. 1945.). East-central Missouri to northwestern Arkansas; southwestern Arkansas and southeastern Oklahoma; southeastern Texas.

3. **Rudbeckia fulgida** Ait. This is one of the most complex species of subgenus *Rudbeckia*. Most of the varieties occupy fairly definite geographic ranges but there is great overlap in their distribution and morphological intergradation is considerable. The following varieties are recognized:

KEY TO THE VARIETIES OF R. FULGIDA

a. Basal leaves narrowly elliptical, narrowly lanceolate, or narrowly oblanceolate, the blades 1/3 as broad as long (Pennsylvania to Illinois, south to Florida and Louisiana) 3a. var. *fulgida*.

a. Basal leaves broadly elliptical to ovate or nearly orbicular, 1/2 to 2/3 as broad as long.

b. Cauline leaves scarcely reduced in length up the stem, those at and just below the first branch nearly or quite as large as the lower.

c. Stem and leaves densely and retrorsely villous-hirsute, basal leaves coarsely crenate, rarely coarsely serrate, cauline leaves sharply serrate, the teeth usually small and remote (Ohio, Indiana, and Illinois).....3b. var. *deamii.*

c. Stem moderately villous-hirsute, leaves scabrous or strigose, basal leaves entire or obscurely crenate, cauline leaves coarsely serrate, commonly lacerate (Connecticut to Illinois, south to West Virginia) 3c. var. *speciosa.*

b. Cauline leaves diminishing in size gradually up the stem, the uppermost commonly reduced to the proportions of large bracts.

d. Apex of the pales eciliate; rays 2.5–4 cm. long (Michigan, Ohio, and Indiana) .....3d. var. *sullivantii.*

d. Apex of the pales prominently ciliate; rays 1–3 cm. long.

e. Leaves narrowly to broadly ovate, the base usually cordate, occasionally broadly rounded, sparingly pilose on both surfaces (Ohio, south to Alabama and Georgia) .....3e. var. *umbrosa*

e. Leaves elliptical, ovate, or orbicular; the base acute, obtuse, rounded, or truncate, never cordate; leaves minutely strigose or scabridulous.

f. Cauline leaves lanceolate to ovate-lanceolate; rays mostly 1.5–3 cm. long (Missouri and Arkansas to Oklahoma and Texas) ....3f. var. *palustris.*

f. Cauline leaves broadly spatulate, oblanceolate, or pandurate; rays mostly 1–1.5 cm. long (Virginia and Tennessee to northern Florida) 3g. var *spathulata.*

3a. **R. fulgida** Ait. var. **fulgida** (*R. fulgida* Ait., Hort. Kew. **3**: 251. 1789; *R. chrysomela* Michx., Fl. Bor. Am. **2**: 143. 1803; *R. truncata* Small, Bull. Torr. Bot. Club **25**: 478. 1898; *R. acuminata* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1256. 1903; *R. foliosa* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1256. 1903; *R. tenax* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1257. 1903.).

3b. **R. fulgida** Ait. var. **deamii** (Blake), comb. nov. (*R. deamii* Blake, Rhodora **19**: 113. 1917.).

3c. **R. fulgida** Ait. var. **speciosa** (Wenderoth), comb. nov. (*R. speciosa* Wenderoth, Ind. Sem. Hort. Marb. 1828.).

3d. **R. fulgida** Ait. var. **sullivantii** (Boynt. & Beadle) Cronquist, Rhodora **47**: 400. 1945. (*R. sullivanti* Boynt. & Beadle, Biltmore Bot. Stud. **1**: 15. 1901; *R. speciosa* var. *sullivanti* (Boynt. & Beadle) Robinson, Rhodora **10**: 68. 1908.).

3e. **R. fulgida** Ait. var. **umbrosa** (Boynt. & Beadle), Cronquist, Rhodora **47**:400. 1945. (*R. umbrosa* Boynt. & Beadle, Biltmore Bot. Stud. **1**: 16. 1901; *R. chapmani* Boynt. & Beadle, Biltmore Bot. Stud. **1**: 14. 1901.).

3f. **R. fulgida** Ait. var. **palustris** (Eggert), comb. nov. (*R. palustris*

Eggert ex Boynt. & Beadle, Biltmore Bot. Stud. **1**: 16. 1901; *R. coryi* Shinners, Field & Lab. **17**: 59. 1949.).

3g. **R. fulgida** Ait. var. **spathulata** (Michx.), comb. nov. (*R. spathulata* Michx. Fl. Bor. Am. **2**: 144. 1803.).

4. **Rudbeckia mollis** Ell., Sketch **2**: 453. 1823. Southeastern Georgia and northeastern Florida.

5. **Rudbeckia heliopsidis** T. & G., Fl. N. Am. **2**: 310. 1842. Very local, southeastern Virginia to eastern Alabama.

6. **Rudbeckia grandiflora** (Sweet) DC.

KEY TO THE VARIETIES OF R. GRANDIFLORA

a. Leaves conspicuously pilose, the surface soft to the touch, the hairs mostly 1 mm. long or longer; lower portion of the stem distinctly pubescent (Central Arkansas, west to eastern Oklahoma, south to northeastern Texas; Georgia) ..... 6a. var. *grandiflora*.

a. Leaves not conspicuously pubescent, either scabrous or hirsute, or rarely, nearly glabrous, the surface very rough to the touch, the hairs mostly about 0.5 mm. long; lower portion of the stem nearly glabrous (Central Arkansas to Louisiana and eastern Texas) ..... 6b. var. *alismaefolia*.

6a. **R. grandiflora** (Sweet) DC. var. **grandiflora** (*R. grandiflora* (Gmel.) DC., Prodromus **5**: 556. 1836; *Centrocarpha grandiflora* Sweet, Brit. Fl. Gard. (ser. 2) **1**: pl. 87. 1831. The correct author citation for this taxon has been discussed by Shinners in Field and Lab. **17**: 62–63. 1949.

6b. **R. grandiflora** (Sweet) DC. var. **alismaefolia** (T. & G.) Cronquist, Rhodora **47**: 401. 1945. (*R. alismaefolia* T. & G., Fl. N. Am. **2**: 310. 1842.).

7. **Rudbeckia subtomentosa** Pursh, Fl. Am. Sept. **2**: 575. 1814. (*R. tomentosa* Ell., Sketch **2**: 453. 1823; *R. odorata* Nutt., Jour. Acad. Phila. **7**: 78. 1834; *R. subtomentosa* Pursh var. *craigii* Sherff, Rhodora **14**: 164. 1912; *R. intermedia* McLeland, Nat. Hort. Mag. **2**: 16. 1923. Michigan to Wisconsin, southwest to Louisiana and Oklahoma.

8. **Rudbeckia triloba** L.

KEY TO THE VARIETIES OF R. TRILOBA

a. Mature disk 0.6–1.3 cm. broad; rays 0.8–1.7 cm. long.
  b. Stem leaves merely toothed or palmately 3-lobed (Connecticut to Michigan and Iowa, south to Texas and Georgia) ..... 8a. var. *triloba*.
  b. Stem leaves pinnately 5–7-lobed (western North Carolina and western Florida) ..... 8b. var. *pinnatiloba*.
a. Mature disk 1.4–2 cm. broad, rays 1.8–3 cm. long, (western North Carolina and eastern Tennessee) ..... 8c. var. *rupestris*.

8a. **R. triloba** L. var. **triloba** (*R. triloba* L. Sp. Pl. **2**: 907. 1753; *R. Beadlei* Small, Fl. S. E. U. S. ed. 1, 1258. 1903; *R. triloba* L. var. *Beadlei* (Small) Fern., RHODORA **39**: 458. 1937.).

8b. **R. triloba** L. var. **pinnatiloba** T. & G., Fl. N. Am. **2**: 309. 1842; (*R. triloba* L. β *pinnatiloba* T. & G., Fl. N. Am. **2**: 309. 1842; *R. pinnatiloba* (T. & G.) Beadle, Bot. Gaz. **25**: 277. 1898.).

8c. **R. triloba** L. var. **rupestris** (Chickering) Gray, Syn. Fl. N. Am. **1**(2): 260. 1884; (*R. rupestris* Chickering, Bot. Gaz. **6**: 188. 1881.).

9. **Rudbeckia graminifolia** (T. & G.) Boynt. & Beadle, Biltmore Bot. Stud. **1**: 12. 1901. (*Echinacea* ? *atrorubens* β ? *graminifolia* T. & G., Fl. N. Am. **2**: 306. 1842; *R. atrorubens* of Gray, Syn. Fl. N. Am. **1**(2): 259. 1884, not Nutt.).—U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, CROPS RESEARCH DIVISION, BELTSVILLE, MD.

PARAFORMALDEHYDE AS A SOURCE OF FORMALDEHYDE FOR USE IN BOTANICAL COLLECTING

J. S. WOMERSLEY

SINCE 1946 the author has been using the "formalin technique" for the preparation of botanical specimens under tropical conditions. Various modifications have been made to the technique employed since first used in New Guinea.

The method as now used requires the following materials in addition to the usual equipment of a botanist engaged in collecting in tropical forests:—

(1) Newspaper or newsprint, preferably cut by guillotine to 17½″ x 11½″ with the fold on one of the long sides.
(2) Latticed frames, 18″ x 12″, constructed of 1″ x ¼″ dressed timber, spaced 1″ apart in the lattice and nailed at all points of contact between the horizontal and vertical members.
(3) An aqueous solution containing approximately 4% formaldehyde by weight.
(4) A rectangular tank with inside measurements 18½″ x 12½″ and of 12″ depth.
(5) Strong waterproof paper with an inner core of bituminised fibre of the brand known as "Sisalkraft" in Australia.

When collecting in the field botanical specimens are placed individually between sheets of newsprint. Pads of newsprint containing 10 to 12 sheets with fold on the left enclosed in a single folded sheet with fold on the right provide a ready means of collecting the 10–12 duplicates of each species generally secured by the author. Each packet then represents the material collected of each number. These packets are placed between a

pair of the 18″ x 12″ lattice forms which can be held together with straps or several turns of strong string. Considerable pressure can be exerted on the specimens in this way.

On return to the base camp after a day's collecting the bundles may be opened and the specimens repacked into new newspaper if desired. This is frequently necessary and is generally desirable as the specimens are "tamed" after this first pressing. Leaves, flowers and fruits may be arranged to best advantage from the point of view of the final specimen at this stage. Care should be taken when preparing this repacked bundle to use pads of folded newspaper to protect any parts of the specimen of considerable thickness, e.g. fruits, twigs etc. If done carefully the final bundle will be rectangular in shape.

The tank constructed from galvanised sheet iron and heavily painted internally with bituminous paint, is now approximately ⅓ filled with formalin containing 4% formaldehyde. These tanks which are fitted with a good lid and carrying handles make ideal transport boxes for the collecting frames, newspapers etc. The prepared bundles of specimens are then placed into the tanks, more formalin added if necessary to completely cover the bundle and a stone placed on top to ensure that the bundle of specimens remains submerged.

Specimens are left in the tanks for 18 to 24 hours, then removed, drained of free liquid and securely wrapped in "sisalkraft" waterproof paper. For transport by human porterage it is well to sew bundles into a large jute sack of the type used for shipping copra.

The bundles of specimens are then transferred to headquarters where drying facilities using artificial heat are available. Bundles of specimens treated by this technique have been kept for periods up to 3 months without deterioration.

The above technique largely follows that discussed by Schultes (1947), Fosberg (1947), and Lawrence (1951). The use of alcohol in a country such as New Guinea is not very practical in view of the strict legislation which restricts the access of the indigenous population to alcoholic liquors. However, Fosberg's claim that the alcohol increases the wetting properties of the solution may be readily met by the addition of an ounce or so of detergent to the formalin. The actual benefit of such an additive is doubtful except where the plant foliage has a decidedly

waxy epidermis. Perhaps added detergent would be beneficial in handling succulents.

The use of the tanks allows the specimens to be handled with a minimum of inconvenience from the odour of formaldehyde. In any camp the tanks provide welcome seating space even when in use.

A considerable step forward in using formalin in the tropics is claimed by the success achieved using paraformaldehyde powder as a source of formaldehyde. Cartage of liquid is thereby obviated. Hitherto this has been the greatest problem in using formaldehyde in tropical countries; apart from the weight, glass containers are easily broken and tins tend to rust allowing leaks to occur which, if the material is being carried by air, as is frequently so, can cause great inconvenience.

Paraformaldehyde, obtainable commercially as a white powder in sealed tins of convenient weight, will dissolve slowly in cold water to form a solution of formaldehyde. Rate of solution is accelerated by stirring, increase of temperature or the presence of alkali. Under controlled laboratory conditions 20 grams of paraformaldehyde powder was dissolved in 250 mls. of rain water at 64°C in the presence of hexamine, 0.4% by weight, with intermittent shaking in 15 minutes to give a solution of specific gravity 1.023 when cooled to 28.2°C.

From published data and private communications the specific gravity of formalin is approximately equal to $1.00 + \frac{3W}{1000}$ where W is equivalent to the weight per cent of formaldehyde. To facilitate ascertaining the weight per cent of formaldehyde from specific gravity readings (conveniently taken with a clinical urinometer, range 1.000 to 1.050) an easily prepared graph is used.

In practice a bucket containing 2 gallons of water is heated almost to boiling point, about an ounce of hexamine added, removed from the fire and placed in a well ventilated place. The paraformaldehyde is added gently with continuous stirring. The operator should stand on the windward side during this operation. The solution will become clear in 5 to 10 minutes and may then be transferred to the tank to cool overnight. The specific gravity of the solution should be determined when cool and should not be less than 1.012. During use the specific gravity of the solution

should be determined periodically and additional formaldehyde solution prepared and added as required.

In practice the use of formalin as a preservative allows the maximum amount of time in the field to be devoted to collecting. This is an important consideration when the collector is tied to a position which allows only limited time to be spent in the field. Certainly, if time permits, as in the major expeditions devoted only to biological collecting, specimens dried by artificial heat in the field are of excellent quality. Mention must be made of those collected by Mr. L. J. Brass of the Archbold Expeditions and Dr. R. D. Hoogland of the Commonwealth Scientific and Industrial Research Organization during field operations in New Guinea.

However, wherever time is limited the use of the formalin technique is strongly recommended. The quality of the final specimen is little impaired by comparison with the specimen dried directly. Certain advantages, namely inhibition of leaf fall and lack of blackening of the flowers of certain genera, e.g. *Mucuna* and some orchids accrue from the formalin technique. The yellow green colour of the finally dried specimen of aluminium accumulating plants, e.g. *Symplocos*, is retained. However, specimens prepared through the formalin technique are of doubtful value for investigation for pharmacologically active substances. Perhaps formalinized specimens should be so marked in herbaria.

An interesting possibility is the addition of an insecticide to the formaldehype solution which could obviate the use of mercuric chloride poisoning of the dried specimens. No experiments have yet been made but the author is giving consideration to a further improvement in the technique.

Grateful acknowledgement is made to Mr. L. J. Brass who first suggested to me the use of paraformaldehyde and who also furnished data supplied by Du Pont & Co. Inc., U.S.A., relating to the solubility of paraformaldehyde and the use of hexamine, to Mr. G. Hermon Slade of Polymer Corporation Pty. Ltd., Sydney; and to Mr. D. Murty, Senior Chemist, Department of Agriculture, Stock and Fisheries, Rabaul, for data on densities of formaldehyde solutions, and also to Mr. L. S. Smith and the late Mr. C. T. White who first introduced me to the use of formalin in the preparation of botanical specimens.

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NOTES ON SOME JAMAICAN EUGENIAS

GEORGE R. PROCTOR

THE CLASSIFICATION of Jamaican rodwoods presents many unsolved problems. Volume 5 of "Flora of Jamaica" (1926) lists 14 species of *Calyptranthes* and 37 indigenous species of *Eugenia*. Many of these are still very poorly known, and at the same time new, undescribed species are occasionally being found. The identification of specimens is made more difficult by the fact that the key in "Flora of Jamaica" is not dichotomous. Aside from the mere troublesome mechanics of identification with a polychotomous key, one also begins to wonder if some of the taxa (especially those based on few or but a single collection) represent real populations. In some cases further collecting will perhaps show that certain taxa are not specifically distinct, while others will have their distinctness clarified by additional data.

One example of clarification involves two entities occurring in the northern part of the Parish of Clarendon and adjacent areas. These are *Eugenia confusa* and *Eugenia clarendonensis*.

Eugenia confusa is widely distributed in the West Indies and also occurs in southern Florida. *E. clarendonensis* has hitherto been known from a single locality called Peckham Woods, in northern Clarendon, Jamaica. The former species, which also occurs in localities adjacent to Peckham Woods, is usually distinguished by its larger, more narrowly acuminate leaves and "racemose-umbelliform" inflorescence. *E. clarendonensis*, on the other hand, is supposed to have strictly umbelliform axillary flower-clusters. In most other details these two taxa are suspiciously similar, as shown by the following table:

	EUGENIA CONFUSA	EUGENIA CLARENDONENSIS
Plant form	Shrub or small tree	Shrub
Indument	Glabrous	Glabrous
Leaves	4–6.5 cm. long	2.5–4 cm. long
	long-acuminate or sometimes acute or obtuse	obtuse
Midrib	Impressed	Impressed
Glandular dots	Numerous	Numerous
Upper surface	Shining	Shining
Texture	Leathery	Leathery
Petioles	4–8 mm.	3–6 mm.
Inflorescence	"Racemose-umbelliform"	Umbelliform
Flowers	Usually 3–7	1–4 (–8)
Pedicels	8–16 mm. long	10–17 mm. long
Sepals	1.5–2 mm.	1.5–2.8 mm.
Petals	"Twice as long as sepals"	4 mm. long

Eugenia confusa has subglobose fruit 5–6 mm. in diameter, but the fruits of *E. clarendonensis* have never been found at the type locality. It is clear that in the absence of differentiating fruit characters, a breakdown in the distinction based on the leaves and type of inflorescence would probably render the maintenance of *E. clarendonensis* as a species untenable.

Recently, exploration of the Mason River Savanna area of northern Clarendon (about 10 miles east of Peckham Woods at about the same elevation) has revealed a population which appears to combine the leaf-characters of *E. clarendonensis* with the inflorescence-structure of *E. confusa*. However, the fruits (many observed) are obliquely ellipsoidal and clearly distinct from the subglobose ones of *E. confusa*. It is here suggested that this population (collected as *Proctor 16479*) represents a form of *E. clarendonensis* transitional in inflorescence towards *E. confusa*, and that the shape of the fruit in this case affords a more stable basis of distinction between the two taxa than the presence or absence of a short rachis to the inflorescence. The latter character, in fact, may often be of very little significance, though it is a major key-character in "Flora of Jamaica."

In reviewing the meagre available material of *E. clarendonensis* it was necessary to consider a specimen, labelled as this species, collected in the Santa Cruz Mountains, Parish of St. Elizabeth. It was soon obvious that the material could not be equated with any other known Jamaican species, being distinguished from all those with umbelliform inflorescences by its much larger, more

numerous flowers. It is also unlike any species seen from other West Indian islands. It is therefore here proposed as new.

Eugenia perratoni Proctor, sp. nov.

Arbuscula glabra; folia elliptica vel ovato-elliptica, 4–5 cm. longa (petiolis includentibus 3–5 mm.), 2–2.5 cm. lata, apice obtusa vel rotundata subacuminata, coriacea, venis utrinque prominulis, infra cum punctis parvulis obscuris. Inflorescentia terminalis, sessilis et umbelliformis; flores 7–15, pedicellis subcrassis 7–17 mm. longis, bracteolis ovatis, circa 1 mm. longis; calycis tubus 3 mm. longus, 5-lobatus, lobis (sepalis) rotundatis, inaequalibus, 3–5 mm. longis, cum punctis glandulosis numerosis; petala 5 mm. longa, cum punctis glandulosis numerosis. Fruges invisae.

A glabrous shrub; leaves elliptic or ovate-elliptic, 4–5 cm. long (including petioles of 3–5 mm.), mostly 2–2.5 cm. broad, the apex obtuse or very bluntly acuminate, the base broadly cuneate, coriaceous, the veins prominulous on both sides and the margins thickened beneath, very obscurely gland-dotted beneath with the dots faintly pellucid. Inflorescence a sessile terminal umbel of 7–15 flowers, the stout pedicels 7–17 mm. long; bracteoles ovate, about 1 mm. long; calyx usually 5-parted, the tube about 3 mm. long and the lobes (sepals) unequal, roundish, 3–5 mm. long, all parts densely glandular-punctate; petals 5 mm. long, of firm texture and densely glandular punctate. Fruit not seen.

TYPE: *Perraton 153* (Institute of Jamaica *Sheet No. 3760*), collected at Munro College, Santa Cruz Mountains, Parish of St. Elizabeth, elev. c. 2600 ft., on June 4, 1952. The type locality is characterized as being "scrub woodland," which means rather dry second-growth woodland on a rocky limestone substratum. The collector was Christopher Perraton, then a teacher of biology at Munro College.

The writer believes that *Eugenia perratoni* is probably most closely allied to *E. polypora*, described from Dolphin Head Mountain in the Parish of Hanover. It differs from the latter species in having much smaller leaves, terminal instead of axillary inflorescences which are sessile-umbelliform instead of having a rachis, and in having larger flowers with normally 5 instead of 4 sepals. *E. polypora* is described as being a large tree whereas the type plant of *E. perratoni* was a shrub, but this is not a reliable distinction owing to the fact that the former species was collected in virgin forest, while the latter came from second-growth scrub woodland.

It is suggested that here is a relationship somewhat analogous to that between *E. confusa* and *E. clarendonensis*, as described

in the first part of the present paper, and that ultimately when the fruits of *E. perratoni* are collected they may prove similarly of more taxonomic value than the structure of the inflorescence, although there is as yet no evidence that the latter character is unstable in this case.—INSTITUTE OF JAMAICA, KINGSTON.

ANALYSIS OF VEGETATIVE PROPAGATION IN QUERCUS PRINOIDES.—In matters of pure taxonomy, the practicing systematist often overlooks the seemingly insignificant, only to find that "major or minor" characters will not always in themselves serve as criteria for taxa delimitations. An excellent example of this is to be found in the arborescent *Quercus muehlenbergii* Engelm. and its shrubby counterpart, *Quercus prinoides* Willd.

While in the past the two have never been merged as a single entity, various workers have treated them in a variety of ways. One leading manual recognizes the two as distinct on the specific level, but yet another recognizes *Q. prinoides* var. *prinoides* as the shrub, and *Q. prinoides* var. *acuminata* as the tree. As the result of field observation, one soon realizes that the sole distinction between the two is the tree vs. shrub growth habit. Marginal teeth numbers and size of the blade present such a great overlap that they can never be relied on with any certainty, although these are the characters long used by systematists in separating the two. Numerous are the herbarium sheets labeled *Q. prinoides* with leaves of great size and a corresponding larger number of teeth; and the converse is to be found on the sheets labeled *Q. muehlenbergii* with unusually small leaves and "under seven" teeth.

This paper is presented not as a taxonomic treatment of the two taxa, as the author's treatment of these two species, as well as *Q. prinus* L. and *Q. brayi* Small is to appear shortly. The purpose of the paper is rather to show the importance of vegetative propagation as a good character in the distinction of the two taxa, and to supplement the earlier work of Muller (Madroño **11**: 129–137, 1951). It may be added that this writer does not recognize the two as distinct on the specific level, and the names *Q. prinoides* and *Q. muehlenbergii* are here used merely for convenience of reference, pending the publication of the taxonomic treatment.

An excavation of a single specimen of *Q. prinoides* recently in a wooded area in Jefferson County, Kansas, revealed a most significant fact: the plant did not have a tap root as might be expected, but rather was connected by means of a rhizome to a series of aerial shoots in close proximity. This clone, naturally, was extremely uniform in leaf characters. A short distance from this clone another shrub with quite different foliage was observed, and excavation proved that it, too, was clonal, with its several aerial shoots being just as uniform in leaf characters. Shrubs of both systems had cups of last year's acorns still present.

The significance of this is important, both taxonomically and ecologically. Seedlings of *Q. muehlenbergii* never spread vegetatively, and by this seemingly insignificant character, the true shrub can always be distinguished from young trees. In addition, acorns are rarely borne until *Q. muehlenbergii* has reached small tree size, whereas *Q. prinoides* bears at extremely small sizes, usually only a foot or so high. Failure to find flowers early in the season or fruits later does not invalidate the shrub character, however, since the rhizomes of *Q. prinoides* are usually only a few centimeters below the soil surface, and can easily be discovered by scraping the soil for short distances at the base of the assumed shrub with the fingers.

Of equal importance is the survival value of this means of propagation. While *Q. prinoides* usually produces acorns quite abundantly, failure to find seedlings is the rule rather than the exception. The acorns of this species fall very early in the season, and according to Dr. Ronald L. McGregor (oral communication) soon disappear, apparently being eaten by small animals. Those plants which do become established are usually found in more open places, or at the margins of woodlands. As pointed out by Muller (l.c.), the survival, as well as the invasion of surrounding areas, is effected by the rhizomatous nature of propagation.

Neither should the evolutionary significance of this means of vegetative propagation be overlooked. Although cross pollination in all probability occurs, the hazards of seedling establishment are great, and rarely can they be found. Consequently, the populations can be expected to be genetically pure, with the rate of hybridization and ensuing introgression greatly slowed down,

and the swamping of one species by another kept at a minimum. The population maintains itself vegetatively; therefore, it is morphologically uniform.—William M. Keith, Jr., department of botany, university of kansas, lawrence, kansas.

Note on the Habitat of Aster ptarmicoides.—*Aster ptarmicoides* (Nees) T. & G., grows abundantly in low, wet, clayey and presumably calcareous soil in a restricted area along the edge of a golf links at Manchester, Vermont. I have placed a specimen which I collected at this station on August 27, 1956, in the Herbarium of the New England Botanical Club.

In Gray's Manual 8th Ed. (1950) Fernald's key to the §*Orthomeris* to which this species is assigned uses the word "xerophytic" as a diagnostic trait of *A. ptarmicoides.* He describes its habitat as "dry, mostly calcareous, rocks, bluffs and sands." Gray's Manual 7th Ed. (1907) specified the habitat as "dry, calcareous soil." In Britton & Brown (1952) Gleason uses the phrase "prairies and other usually dry places," without referring to its apparent preference for calcareous soils.

An examination of the material in the Gray and New England Botanical Club Herbaria reveals that out of 106 specimens 39 labels give no significant habitat data; 41 were from distinctly xerophytic or dry situations, chiefly calcareous; 19 from low ground, sandy or rocky shores, etc.; 5 from "moist" or "wet" low ground or meadow; and one each from "limey" and "clayey" soil (excluding my specimen). Judging by the localities from which the 39 unannotated specimens were collected I imagine that many of them were from calcareous regions.

Thus, it appears that *A. ptarmicoides* is not a true xerophyte, is probably a calciphile, and frequently occurs in moist to wet soils. Perhaps future printings of Gray's and Britton & Brown's should reflect the foregoing observations.—Richard J. Eaton, lincoln, massachusetts.

Volume 59, number 707, including pages 273–292 was issued 20 December, 1957.

ERRATA

Page 14, line 13; *for* Tatuxent, *read* Patuxent.
Page 37, line 16; for *Ternstroemia*, read *Ternstroemia*.
Page 40, line 19; for *texana*, read *texanum*.
Page 160, line 20; *for* Tatum, *read* Tatnall.
Cover, No. 703, line 10; for *Inquirendae et Addendae*, read *Inquirenda et Addenda*.
Page 181, line 26; for *inquirendae et addendae*, read *inquirenda et addenda*.
Page 192, line 9; *for* Arkanass, *read* Arkansas.
Page 248, line 29; for *grandiflora*, read *pterichoides*.
Page 263, line 14; *for* Gorton, *read* Gordon.

INDEX TO VOLUME 59

New scientific names and combinations are printed in bold face type

Abies fraseri 252, 253, 257
Acacia 118
Acer rubrum 256, 257; saccharinum 256; saccharum 258; spicatum 257
Adams, W. P., A Revision of the Genus Ascyrum (Hypericaceae) 73
Adventitious and Escaped Plants New to Missouri 27
Adventive Plants in New York 17
Aegilops cylindrica 123
Aesculus assamica 200; californica 185, 200; carnea 186, 200, 201; discolor 46; flava var. purpurascens 199; georgiana 45, 50; var. pubescens 45, 50; glabra 50, 185, 188, 189, 191, 192, 193, 199, 201; f. marylandica 188; var. arguta × pavia 192; × octandra 188, 189, 191; × pavia 189, 192; × sylvatica 186; glaucescens 193, 194; harbisonii 45; hippocastanum 185, 186, 201; hybrida 198, 199; indica 200; marylandica 186; mutabilis 194; octandra 50, 185, 188, 189, 190, 191, 192, 193, 194, 196, 197, 198, 199, 201, 256, 258; var. hybrida 199; var. purpurascens 199; × pavia 198; × (pavia × sylvatica) 197; × sylvatica 186, 189, 193; parryi 185, 200; parviflora 185, 201; pavia 46, 47, 48, 49, 50, 185, 186, 189, 191, 192, 193, 195, 196, 197, 198, 199, 201; var. arguta 198; (× glabra) 191; × sylvatica 45, 189, 194, 196, 198; (× sylvatica) 196; plantierensis 186, 200, 201; sylvatica 46, 47, 48, 49, 50, 185, 189, 193, 194, 195, 196, 197, 198, 199; (× pavia) 196; turbinata 200; versicolor 198; woerlitzensis 197, 198; var. ellwangeri 197
Aesculus × arnoldiana 189; × bushii 192; × dupontii 197, 198; var. hessei 197; × harbisonii 194; × mississippiensis 192; × mutabilis 195; × mutabilis var. harbisonii 194; var. induta 194; var. penduliflora 194
Agropyron dasystachyum 123, 124; desertorum 123; repens 230; f. aristatum 230; smithii 230; var. molle 123
Agrostis alba 231; var. palustris 231; palustris 231; perennans var. aestivalis 231; scabra f. tuckermani 231
Alchemilla arvensis 18, 19; microcarpa 18, 19
Alopecurus pratensis 231
Alternanthera in Virginia 239
Alternanthera philoxeroides 239
Althaea rosea 28
Amaranthus albus 18; crispus 18
Amblystegiella confervoides 26; subtilis 26
Amelanchier alnifolia 120; arborea 122; Bartramiana 122; humilis 120; **Quinti-Martii** Plate 1228, **121**, 122; spicata 120; stolonifera 120
Amphidium lapponicum 26
Analysis of Vegetative Propagation in Quercus prinoides 306
Anamodon attenuatus 258; minor 256
Anastrophyllum michauxii 252; minutum 253
Andrews, A. L., Bryophytes of the Mount Greylock Region V. 25
Andropogon gerardi 124
Anomylia cuneifolia 253
Anthriscus sylvestris 6, 19
Aphaerema spicata 18
Arabis Holboellii 68
Arctium in Illinois 44
Arctium lappa 44, minus 44; f. pallidum 32; tomentosum 44
Aristida basiramea 32; intermedia 231; longespica 231; purpurascens 231
Arrhenatherum elatius 234
Artemisia absinthium 289; frigida 289

Asclepias incarnata 7
Ascyrum amplexicaule 93; calcinium 94; coriaceum 94; cruciatum 94; Crux-Andreae 79, 94; β angustifolium 81; Cubense 93; cuneifolium 88, 90; edisonianum 77, 91, 92; filicaule 75; glandulosum 94; grandiflorum 88; helianthemifolium 87; humifusum 94; Hypericoides 81, 88; var. multicaule 87; var. oblongifolium 82; var. typicum 82; hypericoides 74, 77, 79, 80, 81, 82, 83; var. multicaule 80, 81, 87; var. hypericoides 80, 81, 83, 84, 85, 87; involutum 94; linifolium 81; macrosepalum 82; monogynum 94; montanum 81; multicaule 87; oblongifolium 81; pauciflorum 77; Plumieri 82; pumilum 77; sibiricum 94; simplex 94; spathulatum 87; stans 77, 88, 90, 91, 92, 93; tetragonum 94; tetrapetalum 77, 81, 93; villosum 94
Ascyrum (Hypericaceae), A Revision of the Genus 73
Asimina triloba 257
Asplenium bradleyi 127
Asterella Ludwigii 26; tenella 26
Aster laevis f. Beckwithiae 32; puniceus f. candidus 32; Ptarmicoides 308
Astragalus Chandonnettii 8; striatus 8; **f. Chandonnettii** 8
Astranthium integrifolium 40
Atrichum undulatum 254
Atriplex argentea 289; glabriuscula 6
Auliza Wilsoni 248

Baldwin, J. T. Jr., Monotropis Lehmaniae not a Real Species 259
Bazzania denudata 253, 254; nudicaulis 253
Beaman, J. H. and Schultes, R. E., Notes on Orchids from La Bayamesa, Cuba 245
Beckmannia syzigachne 31
Berchemia scandens 258
Betula lenta 256; lutea 257, 258; populifolia 122
Blake, S. F., Review of the Genus Cladonia in the District of Columbia and Vicinity 56; A New Cruciferous Weed, Calepina irregularis, in Virginia 278
Blake, S. F., and Dayton, W. A., Ivar Tidestrom, 1864–1956 161
Bouteloua curtipendula 127
Brachythecium Novae-Angliae 26
Braun, E. L., Dentaria laciniata from Seed, 267
Bromus ciliatus 232; inermis 231; japonicus 231; latiglumis 232; f. incanus 232; nottawayanus 232; pubescens 232; purgans 232; rigidus 27, 232; sterilis 232; villosus 232
Bryophytes of the Mount Greylock Region V 25
Bryum pendulum 26
Buxbaumia indusiata 25; subcylindrica 26

Calanthe mexicana 246, 247, 249; var. lanceolata 246
Calepina corvini 278; irregularis 278; f. major 279
Calypogeia fissa 253, 255, 256; meylanii 255; muelleriana 255, 256; neesiana 255; portoricense 256; suecica 255; sullivantii 253, 256
Canada, A New Amelanchier of Eastern 119
Cardaria Draba 29; pubescens 29
Cardiospermum halicacabum 127
Carduus acanthoides 6
Carex amphibola var. turgida 8; brevior 34, 35; comosa 263; decomposita 127; festucacea 34; grayii 127; var. hispidula 126; grisea 8; hystricina f. Dudleyi 7; intumescens 127; lousianica 126; molesta 33, 34, 35, 36; muskingumensis 126; normalis 34, 35; oligocarpa 127; oxylepis 126; tenera 34; tincta 34; **turgida** 8
Carex molesta in Massachusetts 33
Carya ovata 8; var. Nuttalli 7, 8

Centaurea montana 6
Centrocarpha grandiflora 298
Cephalozia catenulata 26, 254, 255, 258; macrostachya 253, 254, 255; pleniceps 26
Cephaloziella byssacea var. scabra 254
Cerastium brachypodum 8
Chenopodium glaucum 287; polyspermum 126; rubrum 289
Chicago Region, Notes on the Grass Flora of the 230; Plants New to Illinois and the 31, 289

Chromosome Numbers in the Higher Plants 241
Cibotarium divaricatum 71; fruticulosum 70; macropetalum 71; macrum 71; **microcarpum** 70; stellatum 70
Cicuta bulbifera 263
Cladonia alpicola var. karelica 60; apodocarpa 60; atlantica 58, 59; f. ramosa 60; f. subsimplex 60; bacillaris 59; f. clavata 39; boryi 59; brevis 60; caespiticia 60; capitata f. imbricatula 60; caroliniana 57, 59; f. dilatata 59; f. fibrillosa 59; f. prolifera 59; f. tenuiramea 59; chlorophaea 58, 60; f. simplex 60; clavulifera 60; f. nudicaulis 60; f. pleurocarpa 60; f. subvestita 60; coccifera 58, 59; var. stemmatina 59; var. phyllocoma 59; coniocraea 60; f. ceratodes 60; f. phyllostrota 60; f. truncata 60; conista 58; f. simplex 60; cristatella 59; f. beauvoisii 59; f. ochrocarpia 59; f. pleurocarpa 59; f. ramosa 59; f. squamulosa 59; f. vestita 59; cryptochlorophaea 58, 60; delicata f. quercina 59; didyma 58; fimbriata 58; floerkeana 58; var. intermedia 58; floridana 59; f. brachiata 59; f. elegans 59; f. esquamosa 59; foliacea var. alcicornis 61; furcata 59; var. pinnata f. foliolosa 59; f. turgida 59; var. racemosa 59; f. squamulifera 59; f. subclausa 59; grayi 57, 58, 60; f. carpophora 60; f. cyathiformis 60; f. squamulosa 60; impexa 58; f. condensata 58; f. laxiuscula 58; incrassata 59; f. squamulosa 59; macilenta f. styracella 59; mateocyatha 61; f. squamulata 61; mitis 58; mitrula 60; paludicolor 59; papillaria 58; f. molariformis 58; f. papillosa 58; f. prolifera 58; f. stipata 58; piedmontensis 61; f. lepidifera 61; f. obconica 61; f. phyllocoma 61; f. squamulosa 61; pityrea 61; var. zwackhii f. hololepis 61; f. subacuta 61; pleurota 59; f. decorata 59; var. cerina 59 var. frondescens 59; polycarpia 58, 60; pyxidata 60; var. neglecta f. lophyra 60; f. simplex 60; rangiferina 58; f. crispata 58; robbinsii 61; squamosa 58, 59; f. denticollis 59; squamosa f. levicorticata 59; m. rigida and m. pseudocrispata 59; f. turfacea 59; f. phyllocoma 59; f. sessilis 59; f. squamosissima 59; strepsilis 61; f. coralloidea 61; f. glabrata 61; f. subsessilis 61; subcariosa 60; f. epiphylla 60; f. evoluta 60; f. pallida 60; f. ramosa 60; f. squamulosa 60; submitis 58; subtenuis 58; f. cinerascens 58; sylvatica 58; f. pygmaea 58; f. sphagnoides 58; tenuis 58; uncialis 59; f. dicraea 59; f. humilior 59; f. obtusata 59; f. subobtusata 59; verticillata 61; f. apoctita 61; f. evoluta 61; f. phyllocephala 61; f. phyllophora 61; vulcanica 58
Cladonia in the District of Columbia and Vicinity, Review of the Genus 56
Cody, W. J., Draba lanceolata in the Ottawa District 237
Cololejeunea biddlecombiae 254, 256, 257, 258; minutissima 256, 257
Conspectus of the Genus Oeno-

thera in Eastern North America, A 9
Contributions to the Flora of Southern Ilinois 125
Coryanthes macrantha 281
Cranichis grandiflora 248
Cratoneuron filicinum 26
Cronquist, A., Fraser's Catalogue Again 100
Crookea microsepala 76
Cryptophila pudica 260
Cuba, Notes on Orchids from La Bayamesa 245
Cycloloma atriplicifolium 160
Cycloloma in Maryland 160
Cynosurus echinatus 17

Dayton, W. A. and Blake, S .F., Ivar Tidestrom, 1864–1956 161
Dentaria diphylla 180, 181; heterophylla 180, 181; laciniata 180, 181, 267, 268, 269; multifida 180, 181, 269
Dentaria in Indiana and Ohio 180
Dentaria laciniata from Seed 267
Descurainia sophia 127
De Wolf, G. P., Chromosome Numbers in the Higher Plants 241
Dianthus deltoides 33
Dichaea glauca 247; trichocarpa 247
Dicranum condensatum 254
Diodea teres 160
Distichlis stricta 123
Distributional and Nomenclatural Notes on Galium (Rubiaceae) 38
Ditrichum pallidum 253, 254
Dolichos lablab 19
Draba cuneifolia 126; lanceolata 238, 239; nemorosa 237
Draba lanceolata in the Ottawa District 237
Drosera filiformis 228; var. Tracyi 228
Drury, W. J. Jr., A Needed Revision (Review) 272; A Posthumous Edition (Review) 290

Eaton, R. J., Carex molesta in Massachusetts 33; Echinochloa Walteri in Concord, Massachusetts 262; Notes on the Habitat of Aster ptarmicoides 308
Echinochloa Walteri in Concord, Massachusetts 262
Edwin, G., Notes on Ilex 20
Eleusine indica 232
Elymus interruptus 125; villosus f. arkansanus 232
Epidendrum Broadwayi 281, 282, 283, 284; cochleatum 248; crassilabium 248; laxum 284; macrothyrsis 284; repens 248; Rousseaueae 284; tipuloideum 281, 282, 283, 284; yatapuense 284
Ephistephium ellipticum 284, 285; minutum 285; tenuifolium 284, 285
Eragrostis cilianensis 232, 233; frankii 232; poaeoides 232, 233
Erianthus ravennae 123, 124; Ravennae 28
Erythrodes hirtella 287; plantaginea 286; **Schultesiana** 286, 287; trinitatis 285, 287; xystophylla 287
Eugenia clarendonensis 303, 304, 305; confusa 303, 304, 305; **perratoni** 305, 306; polypora 305
Eupatorium coelestinum 33
Evers, R. A., and Thieret, J. W., New Plant Records: Illinois and Indiana 182; Notes on Illinois Grasses 123
Ewan, J., Susan McKelvey's History: An Appreciation with Some Incidental Inquirenda et Addenda (Review) 182

Fagus grandifolia 258
Festuca arundinacea 27; elatior 233; gigantea 18; obtusa 233
Fissidens osmundoides 26
Florida, Hymenocallis littoralis from 99
Franseria discolor 30, 31
Fraser's Catalogue Again 100
Fraxinus quadrangulata 127
Frullania asagrayana 252, 257; brittoniae 256, 257; eboracensis 257;

inflata 256, 257; kunzei 257; oakesiana 257; obcordata 257; plana 256, 258; saxicola 256, squarrosa 256; tamariscii 256
Fuertesiella grandiflora 248; pterichoides 248

Gaillardia aristata 100; fimbriata 177; grandiflora 100
Galardia amara 131; fimbriata 102, 103, 104, 149, 152, 153, 154, 168, 173, 174, 175, 178, 203
Galium boreale 40, 42; ssp. septentrionale 40; brevipes 39, 41; labradoricum 39, 40, 41; obtusum 40; septentrionale 40, 42; texanum 40; tinctorium 40
Galium (Rubiaceae), Distributional and Nomenclatural Notes on 38
Gates, R. R., A Conspectus of the Genus Oenothera in Eastern North America 9
Geocalyx graveolens 252
Glassman, S. F., Notes on the Grass Flora of the Chicago Region 230
Glyceria pallida 125
Greylock Region V, Bryophytes of the Mount 25
Godfrey, R. K. and Wood, C. E. Jr., Pinguicula (Lentibulariacea) in the Southeastern United States 217
Grindelia squarrosa 100
Gymnostomum aeruginosum 26; curvirostrum 26
Gypsophila scorzonerifolia 32

Hardin, J. W., Studies in the Hippocastanacea III. A Hybrid Swarm in the Buckeyes 45; IV Hybridization in Aesculus 185
Harpanthus scutatus 252
Hedera Helix 30
Hedyotis minima 95; **f. albiflora** 95
Heleniastrum brevifolium 205; Curtisii 205; fimbriatum 150; Helenium 169; nudiflorum 211; vernale 169
Helenium **amarum** 131; atropurpureum 210; var. grandicephalum 211; atumnale 104, 110, 111, 116, 145; badium 131; brachypoda 211; brevifolium 107, 108, 109, 112, 113, 132, 134, 135, 137, 138, 139, 140, 141, 142, 143, 146, 149, 152, 154, 205, 207, 208, 210, 219; campestre 104, 105, 107, 108, 111, 112, 113, 114, 132, 133, 135, 137, 138, 139, 140, 142, 143, 144, 146, 149, 208, 209, 210; Curtisii 104, 205, 207, 208; decurrens 169; denticulatum 169; dichotomum 210; **Drummondii** 107, 108, 112, 113, 131, 134, 135, 138, 139, 140, 142, 143, 149, 154, 173, 174, 203, 204, 208; elegans 137, 144; fimbriata 173, 177, 178; fimbriatum 107, 149, 153, 154, 173, 175, 176, 177, 178, 203; flexuosum 103, 104, 107, 108, 109, 110, 111, 112, 113, 115, 116, 129, 132, 133, 135, 136, 137, 138, 139, 140, 143, 144, 145, 146, 149, 210, 213, 214, 215; floridanum 211, 214, 215; var. aphanactis 211; Godfreyi 211, 214, 215; Helenium 169; incisum 149, 150; integrifolium 205; Leptopoda 169; micranthum 103, 210; nudiflorum 103, 104, 105, 107, 177, 210; var. purpurea 211; Nuttallii 104, 152, 169, 171, 173; var. incisum 150; parviflorum 110; pinnatifidum 102, 106, 107, 108, 109, 112, 113, 131, 132, 133, 134, 135, 138, 139, 140, 141, 142, 143, 148, 149, 150, 155, 156, 157, 158, 171, 172, 174, 175, 204, 208; polyphyllum 104, 211, 213, 214; puberulum 149, 176; scaposum 105, 106; seminariense 211; tenuifolium 131, 240; vernale 102, 103, 107, 108, 109, 112, 113, 114, 131, 133, 134, 135, 138, 139, 140, 141, 142, 143, 149, 150, 152, 153, 155 156, 158, 168, 171, 172, 174, 203, 204, 208
Helianthus salicifolius 32
Herberta tenuis 253
Hesperidanthus linearifolius 66

Hexalectris spicata 240
Hibiscus palustris 264
Holcus halepensis 234
Hymenocallis littoralis 99; palmeri 99
Hymenocallis littoralis from Florida 99
Hymenopappus biennis 96, 97; filifolius var. lugens 97; flavescens var. cano-tomentosus 97; flavomarginatus 97; **glandulopubescens** 97; mexicanus 97; radiatus 96; scabiosaeus var. corymbosus 97
Hypericum Bissellii 76; macrosepalum 76; mutilum 79, 94; myrtifolium 93; pseudomaculatum 40; tetrapetalum 93
Hypnum molluscum 26
Hypochaeris radicata 33
Hystrix patula var. bigeloviana 125, 233

Ilex ambigua f. **channellii** 23; collina 20, 21, 22; f. van-trompii 22; longipes 20, 21 22; f. van-trompii 22; montana 20; opaca 257; verticillata 20, 22, 23; var. padifolia 22
Ilex, Notes on 20
Illinois and Indiana and the Chicago Region, Plants New to 31
Illinois and Indiana, New Plant Records 182
Illinois and the Chicago Region, Plants New to 289
Illinois, Arctium in 44; Contributions to the Flora of Southern 125; Vernonia crinita in 119
Illinois Grasses, Notes on 123
Iltis, H. A., Distributional and Nomenclatural Notes on Galium (Rubiaceae) 38
Indiana and Ohio, Dentaria in 180
Indiana and the Chicago Region, Plants New to Illinois and 31
Indiana, New Plant Records, Illinois and 182
Ionopsis pygmaea 288
Iris prismatica 264

Isley, D., Leguminosae: Nomenclatural Notes 116
Isochilus linearis 248
Isoetes melanopoda 126; f. pallida 126
Isoloba elatior 227; lutea 227; pumila 228; recurva 227
Ivar Tidestrom, 1864–1956 161, plate 1229

Jamaica, B. W. I., A New Species of Ternstroemia from 36
Jamaican Eugenias, Notes on Some 303
James, C. W., A New Variety of Stipulicida setacea 98; Notes on the Cleistogamous Species of Polygala in Southeastern United States 51
Jones, G. N., Vernonia crinita in Illinois 119
Juncus Dudleyi 7; dudleyi 36; platyphyllus 36

Keith, W. M. Jr., Analysis of Vegetative Propagation in Quercus prinoides 306
Kickxia elatine 127
Kobuski, C. E., A New Species of Ternstroemia from Jamaica, B. W. I. 36
Kucera, C. L., A New Tridens Record from Missouri 72; New Plant Station Records in Missouri 240

Lalonde, L. M., A New Amelanchier of Eastern Canada 119
Lapathum alpestris 5
Lathrop, E., Hedyotis minima f. albiflora 95
Lathyrus hirsutus 30
Lavatera assurgentiflora 184
Leguminosae: Nomenclatural Notes 116
Lejeunea bullata 257; flava 257; lamacenna var. geminata 258
Lemna minor 265
Lepanthes Ekmanii 248; Leonii 250; Lindmaniana 248; longicruris 248; pergracilis 250

Lepanthopsis microlepanthes 247, 250
Lepidium perfoliatum 289
Leptocolea cardiocarpa 257
Leptoglottis nuttallii 116, 117
Leptoloma cognatum 233
Leptopoda brachypoda 103, 210; brevifolia 205; decurrens 103, 168, 169, 171, 172, 173, 205; denticulata 168, 169, 172, 173; fimbriata 149, 153, 154, 173, 174, 175, 176, 177, 178, 203, 204; floridana 168; helenioides 168; Helenium 101, 102, 103, 104, 168, 169, 171, 172, 173; incisa 149, 158; pinnatifida 149, 154, 156; puberula 102, 103, 149, 154, 156, 171, 172; var. pinnatifida 149
Leucobryum glaucum 254
Leucodon julaceus 258
Leucolejeunea clypeata 256; unciloba 256, 257
Liatris and Vernonia, White-flowered Forms of 23
Liatris borealis 264; cylindracea 23; f. **Bartelii** 23; squarrosa f. **alba** 182
Lolium multiflorum 17
Lophocolea minor 26
Lophozia bicrenata 26; Helleriana 26; incisa 252; porphyroleuca 26; silvicola 252
Lotus corniculatus 33
Löve, A., and Löve, D., Rumex thyrsiflorus New to North America 1
Löve, A., A New Botanical Masterpiece from Denmark (Review) 269; A New Flora of Greenland (Review) 290
Lycopodium inundatum var. Biglovii 264

Malaxis domingensis 250; umbelliflora 250
Mancoa bracteata 69; **laxa** 68, 69; mexicana 69; pubens 69
Marsupella emarginata 253; paroica 253
Maryland, Cycloloma in 160
Massachusetts, Carex molesta in 33; Echinochloa Walteri in Concord 262
Massey, A. B., Cycloloma in Maryland 160; Alternanthera in Virginia 239
Maxillaria pachyacron 287; Reichenheimiana 287, 288
Medicago arabica 240
Metzgeria conjugata 258; crassipilis 257, 258; fruticulosa 256, 258; furcata 258; var. ulvula 257; hamata 254, 258; myriopoda 258
Mexico and Western Texas, Miscellaneous Cruciferae of 61
Mexico, A New Radiate Hymenopappus from 96
Microlepidozia setacea 255; sylvatica 253, 254
Mikania scandens 264
Mimosa horridula 117, intsia 116
Minnesota, Notes on Flowering Plants in 6
Miscanthus sacchariflorus 31; sinensis 28
Miscellaneous Cruciferae of Mexico and Western Texas 61
Missouri, Adventitious and Escaped Plants New to 27; New Plant Station Records in 240; A New Tridens Records from 72
Misuse of the Term Taxon, The 43
Mnium orthorhynchum 26
Modest Plea in Favor of Divers Taxons, A 235
Mohlenbrock R H., and Voigt, J. W., Contributions to the Flora of Southern Illinois 125
Monachino, J., Adventive Plants in New York 17
Monarda fistulosa var. mollis 40
Monotropis Lehmaniae 259, 260, 261, 262; odorata 259, 260, 261, 262; Reynoldsiae 261
Monotropis Lehmaniae not a Real Species 259
Montgomery, F. H., Dentaria in Indiana and Ohio 180
Moore, J. W., Notes on Flowering Plants in Minnesota 6

Morton, C. V., The Misuse of the Term Taxon 43
Mühlenbach, V., Adventitious and Escaped Plants New to Missouri 27
Muhlenbergia frondosa f. commutata 233; glomerata 233
Mylia cuneifolia 253

Nardia geoscyphus 253; lescurii 253, 254, 255, 256; obscura 26
Nasturtium microtites 71
Needed Revision, A (Review) 272
New York, Adventive Plants in 17
North America, A Conspectus of the Genus Oenothera in Eastern 9; Rumex thyrsiflorus New to 1
Noteworthy Hepaticae from Virginia 251
Nowellia curvifolia 255, 258
Nyssa sylvatica var. biflora 256, 257, 258

Odontoschisma prostratum 253, 254
Oenothera albinervis 15; ammophila 16, ammophiloides 11; var. **flecticaulis** 11; var. laurensis 11; var. **parva** 12; angustissima 12; var. quebecensis 12; apicaborta 12; argillicola 13; atrovirens 13; var. **Ostreae** 13; biennis 16; var. **cantabrigiana** 16; var. hirsutissima 15; var. leptomeres 16; biformiflora 12; var. cruciata 12; brevi-capsula 14, 16; caespitosa 100; canovirens 14; var. **cymatilis** 14; cantabrigiana 16; cespitosa 100; cheradolphila 15; chicaginensis 14; cleistantha 13; Cockerelli 15; comosa 11; cruciata 13; var. sabulonensis 14; var. stenopetala 14; cymatilis 14; deflexa 13; var. brachteata 13; depressa 15; disjuncta 14; Drummondii 16; eriensis 13; var. **niagarensis** 13; var. **repandodentata** 13; flecticaulis 11; franciscana 16; furca 14; gauroides 16; var. **brevicapsula** 16; grandiflora 13; var. **Tracyi** 13; grandifolia 11; Hazelae 11; var. parviflora 11; var. subterminalis 11; hemifusa 16; Heribaudii 15; heterophylla 16; Hewetti 16; hirsutissima 15; Hookeri 15; var. **angustifolia** 15; var. **franciscana** 16; var. grisea 16; var. **Hewettii** 16; var. **hirsutissima** 15; var. **irrigua** 15; var. parviflora 16; var. **Simsiana** 16; var. **venusta** 16; insignis 14; intermedia 11; irrigua 15; Jamesii 15; laciniata 16; laevigate 13; var. rubipunctata 13; var. **scitula** 13; var. similis 13; leucophylla 12; litorea 16; longissima 15; Macbrideae 15; var. **ornata** 15; macrocarpa 100; macrosceles 15; macrosiphon 15; magdalena 12; missouriensis 10, 100; muricata 16; var. canescens 16; niagarensis 13; Nobska 14; Oenothera novaescotiae 11; var. distantifolia 11; var. **intermedia** 11; var. serratifolia 11; numismatica 16; nutans 13; Oakesiana 14; var. **Nobska** 14; var. **Tidestromii** 14; organensis 10, 15; ornata 15; Ostreae 13; paralamarckiana 14 parva 12; parviflora 16; perangusta 14; var. rubricalyx 14; pratincola 16; var. **numismatica** 16; procera 15; pycnocarpa 13; var. parviflora 13; var. cleistogama 13; repandodentata 13; Reynoldsii 16; rhombipetala 16; Robinsonii 14; Royfraseri 12; rubescens 14; rubricapitata 15; ruderalis 16; sackvillensis 12; var. albiviridia 12; var. **Royfraseri** 12; scitula 13; Shulliana 14; Simsiana 16; stenomeres 14; strigosa 14; var. **albinervis** 15; var. **cheradolphila** 15; var. **Cockerellii** 15; var. **procera** 15; var. **subulifera** 15; subulifera 15; subterminalis 11; syrticola 16; Tidestromii 14; Tracyi 13; venosa 13; venusta 16; Victorinii 12; var. intermedia 12; var. parviflora 12; var. undulata 12

Oenothera in Eastern North America, A Conspectus of the Genus 9
Ohio, Dentaria in Indiana and 180
Onagra ornata 15; strigosa subulata 15
Onopordon acanthium 6
Ophioglossum engelmanni 126
Orchidaceae Neotropicales III. De Orchidaceis Insularum Trinidad et Tobago Notulae Additiciae 280
Orthotrichum obtusifolium 26
Oryzopsis caduca 273; hymenoides 273, 274, Plate 1230, 275, 276; **Oryzopsis hymenoides** × **Stipa neomexicana** Plate 1230, 276
Ottawa District, Draba lanceolata in the 237
Oxalis Dillenii var. radicans 267; recurva 267; sanguinolaria 267

Panicum implicatum 233; meridionale 233; miliaceum 28; texanum 28
Paraformaldehyde as a Source for Formaldehyde for use in Botanical Collecting 299
Paraleucobryum longifolium 253
Paronychia fastigiata 33
Paspalum stramineum 233; ciliatifolium var. stramineum 233
Patterson, P. M. and Schuster, R. M., Noteworthy Hepaticae from Virginia 251
Pavia arguta 198; hybrida 198; lindleyana 198; livida 198; mutabilis 194; versicolor 198
Penstemon Digitalis 6; tidestromii 166
Perdue, R. E., Jr., A New Variety of Rudbeckia california 289; Synopsis of Rudbeckia Subgenus Rudbeckia 293
Persicaria bicornis 265
Peteria glandulosa 216; scoparia 216; Thompsonae 216
Petunia axillaris 30
Phalaris canariensis 278
Photinia villosa 19
Physalis ixocarpa 182; macrophysa 8
Phragmites communis var. Berlandieri 240, 265
Picea rubens 252
Pinguicula alpina 223, 225; australis 228; caerula 217, 218, 219, 223, 225, 226, 227; campanulata 227; edentula 227; elatior 227; floridensis 228; grandiflora 225; lusitanica 217; lutea 217, 219, 224, 225, 226, 227, 228; planifolia 217, 218, 219, 221, 225, 226, 229; **primuliflora** 218, 219, 221, 222, 224, 225, 226, 229; pumila 217, 218, 219, 221, 224, 225, 226, 228, 229; var. Buswellii 228, 229; villosa 225; vulgaris 223, 224, 225; P. × hybrida 225; × Scullyi 225
Pinguicula (Lentibulariaceae) in the Southeastern United States 217
Pinus strobus 120, 122
Plagiochila sullivantii 254; tridenticulata 253; yokogurensis subsp. fragilifolia 254, 256
Plagiothecium denticulatum 258
Plants New to Illinois and Indiana and the Chicago Region 31
Plants New to Illinois and to the Chicago Region 289
Plateilema Palmeri 106
Pleurothallis microlepanthes 250; prostrata 250; racemiflora 250; ruscifolia 250
Poa alsodes 234; languida 234; palustris 234; trivialis 233, 234
Pohlia annotina var. decipiens 26; proligera 26; Rothii 26
Polygala aboriginum 51, 55; **crenata** 51, 52, 53, 54, 55; lewtonii 51, 52, 53; polygama 51, 52, 53, 54, 55; f. albiflora 55; f. obovata 51, 54; var. abortiva 55; var. obtusata 51, 55; var. ramulosa 55
Polygala in Southeastern United States, Notes on the Cleistogamous Species of 51
Polygonum bicorne 265; cespitosum var. longisetum 31; longi-

stylum 265; maculatum 265; vernum 265
Polygonum bicorne Raf. Instead of P. longistylum Small 265
Populus canescens 33
Porella platyphylloidea 256, 258
Porter, C. L., Range Extensions in the Genus Peteria (Leguminosae) 216
Posthumous Edition, A (Review) 290
Potamogeton panormitanus 265; pusillus 265
Prinos padifolius 22
Proctor, G. R., Notes on Some Jamaican Eugenias 303
Prunus mexicana 126
Pseudocymopterus tidestromii 166
Psilochilus [illegible]crophyllus 250
Pteridium aquilinum var. latiusculum 240
Pterigynandrum filiforme 26
Ptilidium ciliare 259; pulcherrinum 259
Puccinellia distans 27
Pyrularia pubera 18
Pyrus melanocarpa 122

Quekettia **pygmaea** 288
Quercus brayi 306; muehlenbergii 306, 307; prinoides 306, 307; var. acuminata 306; var. prinoides 306; prinus 306; virginiana 254

Radula caloosiensis 254, 256, 258; complanata 256, 258; langloisii 256; obconica 254, 256, 258; tenax 254, 258
Range Extensions in the Genus Peteria (Leguminosae) 216
Raphanus Raphanistrum 29
Rectolejeunea maxonii 256, 258
Review of the Genus Cladonia in the District of Columbia and Vicinity 56
Revision of the Genus Ascyrum (Hypericaceae), A 73
Revision of the Vernal Species of Helenium (Compositae), A 101; 128, 168, 203
Rhacomitrium heterostichum 26
Riccardia latifrons 258; multifida 26, 258; palmata 258; pinguis 26
Rock, H. F. L., A Revision of the Vernal Species of Helenium (Compositae) 101, 128, 168, 203
Rollins, R. C., Miscellaneous Cruciferae of Mexico and Western Texas 61
Rorippa heterophylla 18; indica 17, 18; **microtitis** 71
Rubus enslenii 126
Rudbeckia acuminata 297; alismaefolia 298; amplectens 295; atrorubens 299; Beadlei 299; bicolor 296; brittonii 295; californica var. californica 290; var. glauca 290; var. **intermedia** 289; chapmani 297; chrysomela 297; coryi 298; deami 297; divergens 296; flava 296; var. perbracteata 296; flexuosa 296; floridana 296; var. angustifolia 296; foliosa 297; fulgida 293, 294, 296, 297; var. **deamii** 297; var. fulgida 296, 297; var. missouriensis 296; var. **palustris** 297; var. **spathulata** 297, 298; var. **speciosa** 297; var. sullivantii 297; var. umbrosa 297; graminifolia 293, 294, 299; grandiflora 294, 298; var. alismaefolia 298; var. grandiflora 298; heliopsidis 294, 298; hirta 293, 294, 295; var. **angustifolia** 295, 296; var. brittonii 295; var. corymbifera 295, 296; var. **floridana** 295, 296; var. hirta 295; var. monticola 295; var. pulcherrima 293, 295, 296; var. sericea 296; intermedia 298; lanceolata 296; longipes 296; missouriensis 294, 296; mollis 294, 298; monticola 295; odorata 298; palustris 297; pinnatiloba 299; rupestris 299; sericea 296; serotina 296; var. lanceolata 296; var. corymbifera 296; var. sericea 296; spathulata 298; speciosa 297; var. sullivantii 297; strigosa 296; subtomentosa 294, 298; var. craigii 298; sullivantii

297; tenax 297; tomentosa 298; triloba 293, 294, 298, 299; var. Beadlei 299; var. pinnatiloba 298, 299; var. rupestris 298, 299; var. triloba 298, 299; β pinnatiloba 299; truncata 297; umbrosa 297
Rumex Acetosa 2, 3, 5; alluvius 7; alpestris 2, 3, 5; ambiguus 2, 3, 5; arifolius 5; domesticus 7; montanus 5; odontocarpus 7; thyrsiflorus 1, 2, 3, 4, 5
Rumex thyrsiflorus New to North America 1

Salsola atriplicifolia 160; platyphylla 160
Sanvitalia procumbens 32
Sarcosphaera ammophila 17
Sarracenia flava 207
Scapania hyalinum 253; mucronata 26; nemorosa 253; obscurum 253; undulata 253
Schrankia microphylla 116, 117; nuttallii 116, 117; uncinata 116, 117, 118
Schultes, R. E., Orchidaceae Neotropicales III. De Orchidaceis Insularum Trinidad et Tobago Notulae Additiciae 280
Schultes, R. E. and Beaman, J. H., Notes on Orchids from La Bayamesa, Cuba 245
Schuster, R. M. and Patterson, P. M., Noteworthy Hepaticae from Virginia 251
Schwetschkeopsis denticulata 256
Sematophyllum adnatum 257
Senecio viscosus 289
Setaria faberi 234; glauca 234; lutescens 234; verticillata 234; viridis 234; viridis × faberi ? 234
Shinners, L. H., Sisyrinchium Bermudiana L. Instead of S. angustifolium Miller 159; A Modest Plea in Favor of Divers Taxons 235; Polygonum bicorne Raf. Instead of P. longistylum Small 265
Sibara Viereckii var. Endlichii 62
Silene dichotoma 29; regia 33
Sisymbrium linearifolium 66, 68; Loeselii 7, 29; **longipes** 65, 66, 68; microtites 71; **retrofractum** 66, 67, 68
Sisyrinchium angustifolium 159, 160; Bermudiana 159; graminoides 159, 160; iridioides 159; montanum var. crebrum 160; mucronatum 159
Sisyrinchium Bermudiana L. Instead of S. angustifolium Miller 159
Solanum sarachoides 19; tuberosum 30; villosum 20
Solenostoma hyalinum 253; obscurum 252, 256
Sorbus americana 257
Sorghum halepense 234; vulgare var. drummondi 124; var. technicum 28
Spartina pectinata 124
Spermolepis divaricata 40; echinata 40
Sphaerocarpus terrestris 258; texanus 258
Sphagnum fuscum 26; robustum 26; subsecundum 253; Warnstofianum 26
Spiranthes ovalis 127
Sporobolus asper 234
Stanleyella Wrightii 64
Stelis ophioglossoides 250
Stipa comata 274, 277; neomexicana 274, Plate 1230, 275, 276, 277; robusta 274; scribneri 274; spartea 277; viridula 273, 274; × Stiporyzopsis caduca 273; viridula × Oryzopsis hymenoides 273
Steyermark, J. A., Swink, F. A. and Thieret, J. W., Plants New to Illinois and Indiana and the Chicago Region 31
Steyermark, J. A., White-flowered Forms of Liatris and Vernonia 23
Stipulicida setacea 98; var. **lacerata** 98; var. setacea 98
Studies in the Hippocastanaceae III. A Hybrid Swarm in the

Buckeyes 45; IV. Hybridization in Aesculus 185
Susan McKelvey's History: An Appreciation with Some Incidental Inquirenda et Addenda (Review) 182
Swink, F. A., Thieret, J. W. and Steyermark, J. A., Plants New to Illinois and Indiana and the Chicago Region 31
Synopsis of Rudbeckia Subgenus Rudbeckia 293

Telaranea nematodes 253, 255
Tephrosia hispidula 227
Ternstroemia from Jamacia, B. W. I., A New Species of 36
Ternstroemia hartii 38; **howardiana** 37, 38
Texas, Miscellaneous Cruciferae of Mexico and Western 61
Thelypodium **Paysonii** 61, 62, 63, 64, 65; **tenue** 62, 64, 65; texanum 62, 64, 65; Wrightii 62, 64, 65
Thieret, J. A., Plants New to Illinois and the Chicago Region 289
Thieret, J. W. and Evers, R. A., Notes on Illinois Grasses 123; New Plant Records: Illinois and Indiana 182
Thieret, J. W., Steyermark, J. A. and Swink, F. A., Plants New to Illinois and Indiana and the Chicago Region 31
Thuraria herbacea 100
Tidestrom, 1864–1956, Ivar 161, plate 1229
Tragia urticifolia 40
Trapa natans 265
Traub, H. P., Hymenocallis littoralis from Florida 99
Trichostomum tenuirostre 26
Tridens flavus 72; oklahomensis 72; strictus 72
Triodea flava f. cuprea 234
Tritomaria exsecta 252, 253
Trizeuxis pygmaea 288

Ulota crispa 257
United States, Notes on the Cleistogamous Species of Polygala in Southeastern 51; Pinguicula (Lentibulariaceae) in the Southeastern 217

Valerianella longiflora 40
Verbascum blattaria 182; thapsus 182; virgatum 182
Vernonia crinita in Illinois 119
Vernonia missurica 23, 24; f. **Swinkii** 24; noveboracensis 264
Vernonia, White-flowered Forms of Liatris and 23
Veronica longifolia 7, 32
Viburnum cassinoides 122; Lantana 32
Vicia dasycarpa 30
Viola Brittoniana 264; tidestromii 166
Virgilia garndiflora 100
Virginia, Alternanthera in 239; A New Cruciferous Weed, Calepina irregularis, in 278; Noteworthy Hepaticae from 251
Voigt, J. W. and Mohlenbrock, R. H., Contributions to the Flora of Southern Illinois 125

Waterfall, U. T., A New Radiate Hymenopappus from Mexico 96
Weber, W. A., A New Intergeneric Hybrid involving Oryzopsis and Stipa (Gramineae) 273
White-flowered Forms of Liatris and Vernonia 23
Winterringer, G. S., Arctium in Illinois 44
Wolffia columbiana 265
Womersley, J. S., Paraformaldehyde as a Source of Formaldehyde for Use in Botanical Collecting 299
Wood, C. E. Jr. and Godfrey, R. K., Pinguicula (Lentibulariaceae) in the Southeastern United States 217

Xylobium palmifolium 251, 288, 289

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